156

P. E. Buffam
U. S. Forest Service
Portland, Oregon
February 10, 1960

RESULTS OF A FIELD TEST TO REDUCE INSECT DAMAGE TO CONES AND SEEDS OF DOUGLAS-FIR

The increasing need for control of seed and cone insects of several Pacific Northwest trees is widely recognized. However, the research needed to develop methods and materials for applying control remains largely undone. To help solve one of the most critical problems--control of insects affecting Douglas-fir--an exploratory study was carried out in 1959 by the U. S. Forest Service on the Shelton and Hoodsport Ranger Districts of the Olympic National Forest. The following report describes how the study was made and what was found.

Acknowledgment is made to Weyerhaeuser Company, particularly Entomologist N. E. Johnson and Forester J. K. Winjum of the Centralia Forestry Research Center, who provided unpublished research data and suggestions that were helpful in planning the study.

OBJECTIVES OF THE STUDY

The main objectives of the test were:

1. To determine if seed yield of Douglas-fir could be increased by spraying with two insecticides that appeared promising.

2. To determine if cone abortion could be reduced by the spray treatment.

3. To learn something about the problems connected with ground spraying for control of seed and cone insects of Douglas-fir.

WHAT WAS DONE

In the winter of 1959, a detailed work plan to guide the study was prepared.[1/] Although the plan was closely followed in most respects, it was necessary to deviate from it in some particulars. Following are the important steps that were taken to carry out the study.

1. Three study areas, spaced several miles apart, were selected. Henceforth, in this report they will be referred to as Dennie Ahl, Hamma Hamma, and Satsop.

2. Twenty-five pairs of sample trees about 15 to 35 feet tall were selected on the Dennie Ahl and Hamma Hamma areas; only 19 suitable pairs could be found at Satsop. One tree of each pair was labeled as a spray tree and the other as a check tree.

1/ Work Plan - A Field Test for Control of Seed and Cone Insects of Douglas-Fir by K. H. Wright and T. E. Greathouse, U. S. Forest Service, Portland, Oregon. April 1, 1959.

3. In late April or early May, when the cone buds were erect and open to receive pollen, the spray tree of each pair was treated from the ground with three to four gallons of a .25 percent water emulsion spray of the insecticide, sevin. This application was made to control the Douglas-fir cone midge (Contarinia oregonensis) which lays its eggs in the conelets while they are open to receive pollen. The larvae cause damage by forming pitchy galls which prevent the seed from being extracted.

4. Approximately 2 weeks later, the spray tree of each pair was treated with DDT at the same dosage and formulation as the sevin. This application was made to control the Douglas-fir cone moth, Barbara colfaxiana, an insect which lays its eggs on the cone scales. The larvae cause damage by mining throughout the developing cone.

5. In late June, counts were made of the number of aborted and developing cones on the sprayed and unsprayed trees.

6. In August, four cones from each of the sprayed and unsprayed trees were picked and sliced once longitudinally to make counts on the number of sound seed, and the number and kind of insects present.

7. In September, all the cones from each tree were picked; subsequently, 10-cone samples were selected at random from each tree's total yield. These were bagged separately by trees. The sample cones were then dried, and the seed extracted and weighed on laboratory scales. A total of 138 samples were handled in this manner.

RESULTS

As indicated above, two methods of assessing effectiveness of the spray were used -- (1) by comparing the seed yield from sprayed and unsprayed trees, and (2) by comparing seed counts and number of insects in sliced cones from sprayed and unsprayed trees.

Seed Yield Comparisons

Results of this test are shown in the following table:

Comparison Factor	AREA (A) Dennie Ahl	(B) Hamma Hamma	(C) Satsop
No. Tree Pairs Sampled	25	23 1/	19
Ave. Seed yield per 10 cones:			
Sprayed trees	4.38 grams	4.16 grams	4.51 grams
Unsprayed trees	3.44 "	4.42 "	2.87 "
Increase or decrease in weight of seed from sprayed trees	21.4% increase	8% decrease	36.4% increase
No. pairs in which sprayed tree yielded more seed than unsprayed tree	18 (of 25)	8 (of 23)	18 (of 19)

1/ Two of the original 25 sample lots were lost during extraction.

Statistical analysis of the variation in seed production between the three plots showed no advantage in favor of the sprayed trees. However, when each plot was considered in itself, the sprayed trees at Dennie Ahl and Satsop produced significantly more seed than the unsprayed.

A review of field notes showed that on the Hamma Hamma area spraying against the cone midge was four or five days later than was considered optimum; this may account for the lack of control there. On the Satsop area, where the best apparent success was obtained, the application was felt to be about three to four days early. Only at Dennie Ahl was timing of the first spray regarded as ideal.

Seed-Cut and Insect-Count Comparisons

This test was not a sensitive one because insects were very scarce at Dennie Ahl and Hamma Hamma, and only moderately abundant at Satsop. The cone midge, and an unidentified scale midge were the only species present in significant numbers on either sprayed or unsprayed trees on any of the areas. The role of the scale midge has not yet been determined. Although the test was disappointing for the above reasons, some interesting data were obtained. They are presented in the following table, which is based on dissections of 540 cones -- half sprayed and half unsprayed.

Comparison Factor	AREA					
	Dennie Ahl		Hamma Hamma		Satsop	
	Sprayed	Unsprayed	Sprayed	Unsprayed	Sprayed	Unsprayed
No. sound seed per cut	4.80	4.05	5.96	4.29	4.96	3.20
No. cone midges per cut	.04	.21	.09	.14	.01	.53
No. scale midges per cut	.15	.20	.09	.47	.67	1.46
Percent of cones showing some insect damage	9	19	8	22	26	54

It will be noted from the table that on all 3 plots the number of sound seed per cut was greatest in cones from sprayed trees. However, the number of sound seed per cut in Douglas-fir is a poor indication of final yield if midges are abundant, because they prevent the seed from being extracted. This may have been the case at Hamma Hamma where the sound seed count was considerably better in sprayed cones than unsprayed, but yield (as shown in the first test) was somewhat less.

Abortion Comparisons

Variation in the number of cones that set and the number that aborted on the 3 plots was high, as shown in the following table. No statistical tests of the data were made, but the arithmetic and percentage comparisons suggest that the spray had no effect on abortion.

Area and treatment	Ave. no. cones per tree	Ave. no. aborted cones	Percent abortion
Dennie Ahl			
Sprayed	265	28	10.5
Unsprayed	376	21	5.6
Hamma Hamma			
Sprayed	122	49	40.2
Unsprayed	131	55	42.0
Satsop			
Sprayed	374	122	36.6
Unsprayed	225	120	53.3
All areas			
Sprayed	254	67	26.4
Unsprayed	244	66	27.0

DISCUSSION OF RESULTS AND RECOMMENDATIONS

The 1959 Douglas-fir seed and cone insect study did not produce a proven method for control of these insects. However, the results strongly suggest that proper timing of an application of the insecticide sevin can cause significant reductions in the Douglas-fir cone midge population, and thus increase seed yield. Indications are that timing of the spray must be very precise, probably a few days prior to the time when the conelets are at maximum receptivity for pollen.

Obviously, no test of the effectiveness of DDT for control of the Douglas-fir cone moth was achieved. In all the cones that were sliced only one moth larva was found -- on an unsprayed tree at Satsop.

The main shortcoming of the study was lack of technical personnel to collect detailed entomological and phenological records at the time of spray application. If careful observations had been made, the reasons for success or failure of treatment on individual plots could likely have been determined. Without such observations, interpretation of results was largely speculation.

For future work, it is recommended that the following investigations be considered, in the order they are listed:

1. Make detailed studies of the time the Douglas-fir cone midge appears in the spring, and relate it to development of the staminate cones, and other phenological events.

2. In test control areas, determine precisely when the adult Douglas-fir cone moths appear in the spring, when they begin laying eggs, when the larvae hatch, and when they enter the cones.

3. Conduct laboratory or small-scale field tests of promising candidate insecticides -- against both the midge and the cone moth.

4. Conduct operational field tests of the screened insecticides, using ground equipment and adequate replication to assure verification of findings.

5. Test the adaptability of ground methods to aerial application.

Prepared by: T. E. Greathouse, Forester
Div. Timber Mgm't.
Regional Office

V. E. Allen, Forestry Aid
Shelton Ranger Dist.
Olympic N. F.

K. H. Wright, Entomologist
PNW Experiment Station

Figure 1. Comparison of seed yield from sprayed and unsprayed Douglas-fir trees on 3 study plots. Olympic National Forest, 1959.